



# Gradient Driven Fluctuations Experiment (GRADFLEX)



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**Engineering Team:** ESA flight hardware contractors

Glenn Research Center

## Objective:

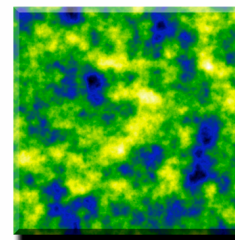
- Study gradient driven-density and concentration fluctuations that are strongly enhanced in fluids by the absence of gravity.
- Achieve a quantitative understanding of gradient driven fluctuations, both on Earth and in the microgravity environment provided during a Foton-M3 mission.

## Relevance / Impact:

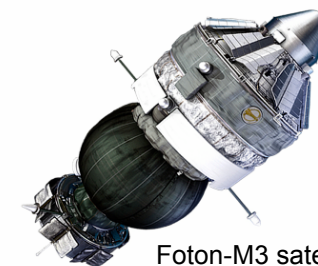
- In reduced gravity, gradients drive giant fluctuations that may impact processes such as crystal growth.
- This experiment was featured on the front-cover of the April 1, 2006 issue of *Applied Optics*.
- The GRADFLEX flight images visually support theoretical predictions by showing a very large increase in the size of the fluctuations in reduced gravity. Data analysis has also shown the amplitude of the fluctuations in temperature and concentration to be greatly increased.

## Development Approach:

- GRADFLEX features two samples, one a single-component fluid of a 3 mm thick layer of carbon disulphide (single-component), and the other a 1 mm thick layer of 1.8 wt. % polystyrene (Molecular Weight 9000) in toluene (mixture). These samples are representative of any single-component fluid or mixture. The samples were driven out of equilibrium by applying temperature differences across the layers; 20 Kelvin for the mixture and up to 30 Kelvin for the single-component fluid.
- ESA / ESTEC is funding the flight hardware and provides ground-based support in Italy.
- NASA funding allowed the development of essential prototype hardware and provides ground-based support in the U.S.



Gradient driven fluctuations visible with a shadowgraph



Foton-M3 satellite

## ISS Resource Requirements

<b>Accommodation</b> (carrier)	Foton-M3 satellite
<b>Upmass (kg)</b> (w/o packing factor)	55
<b>Volume (m<sup>3</sup>)</b> (w/o packing factor)	0.11
<b>Power (kw)</b> (peak)	0.157
<b>Crew Time (hrs)</b> (installation/operations)	None

## Project Life Cycle Schedule

Milestones	PRR	SRR	PDR	CDR	TRR	FAR	FRR	Launch	Ops	Return	Final Report
<b>Actual/ Baseline</b>	30 Jun 03	24 Mar 04	28 Jul 04	20 Jan 06	Sep 2006	Mar 2007	July 2007	14 Sep 2007	Sep 2007	23 Sep 07	Sept 2009
<b>Documentation</b>	Website: eRoom:				SRD: EDMP:			Project Plan: SEMP:			